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MEMORANDUM
December 11, 1985

To: Al Newman

From: Joe Joy

Subject: Goldendale Wastewater Treatment Plant/Little Klickitat River Low-Flow Survey Data and Findings

INTRODUCTION

The data from the August 27-28, 1985, low-flow survey at Goldendale have been reviewed. The following is a brief report including data and findings from the receiving water portion of the survey. Marc Heffner will be summarizing the findings from the concurrent Goldendale wastewater treatment plant (WTP) Class II survey. A second Class II and receiving water survey on the Little Klickitat River at Goldendale is planned during a high-flow situation in March 1986. Data from that survey and further discussion of this low-flow data will be reported sometime after then.

The purpose of this project is to document changes in Little Klickitat River water quality since the Goldendale WTP has been upgraded. The objectives of these surveys were developed in an earlier document (Joy, 1985). They were as follows:

1. Determine the effect of the Goldendale WTP upgrade on the quality of the receiving water under two situations:

   a. Effluent discharge during the summer low-flow period.

   b. Effluent discharge during a higher flow period.

   Oxygen depletion, ammonia and chlorine toxicity, and nutrient enrichment in the Little Klickitat River are possible water quality problems.

2. Compare the data from these surveys to the 1981 survey data.

3. Determine the quality of the well water added by the city of Goldendale and its impact on the Little Klickitat River.

The summarized findings will directly address these objectives.

FLOW CONDITIONS

The August survey was conducted at a time when the Goldendale WTP is not usually discharging effluent to the Little Klickitat River. Usually the WTP effluent is being irrigated onto nearby fields or stored in the lagoons for later discharge into the river during higher in-stream flows.

We requested the WTP operators, Pete Ham and Paul Halm, to discharge both the WTP effluent and the municipal make-up water to the Little Klickitat for our survey. Based on an estimated flow of 6.0 cfs in the Little Klickitat at the staff gage above the WTP outfall (Station 3) (Figure 1), 0.3 cfs was to be discharged from each source to meet the 20:1 dilution requirements of the Goldendale WTP discharge permit. The municipal make-up well discharged 0.3 cfs, but because of a misunderstanding, the WTP discharged 0.3 MGD (0.46 cfs). Therefore, the dilution ratio of the Little Klickitat water to Goldendale WTP effluent averaged 14:1 during the two days. Well and effluent discharging commenced at 1700 hours on August 26, 1985.

The 0.85 cfs average flow of the Little Klickitat at Station 1 during the survey approximated the seven-day, five-year, low-flow event (Figure 9 in Joy, 1983). Bloodgood Creek, a major spring-fed tributary, quadrupled the Little Klickitat flow over Station 1 flows (Table 2; Figure 1). There was a loss of approximately 0.5 cfs between the outfall at river mile 14.1 and river mile 10.5. The time-of-travel estimate for effluent reaching river mile 10.5 was 0.67 day (16 hours). However, 0.8 day (20 hours) had elapsed by the time Station 6 (r.m. 10.5) was sampled on August 27, and chloride and phosphorus sample results indicated effluent had not yet reached that station (Figure 2).

Sample locations and sampling information are shown and described in Figure 1 and Table 1, respectively. Laboratory and field sampling results are presented in Table 2.

FINDINGS

The survey objectives along with noteworthy findings addressing each objective are listed below.

Objective 1a: Effluent Effects on Water Quality

- Effluent had little effect on in-stream dissolved oxygen (D.O.). All D.O. concentrations downstream of outfall were above the Class A criterion of 8 mg/L.

- In-stream ammonia concentrations above and below the WTP outfall were low and probably created neither a toxicity problem nor an oxygen demand.

- Effluent inorganic nitrogen loads were low. Effluent phosphorus loads raised in-stream phosphorus concentrations, but had diminished significantly by river mile 10.5.

- A chlorine residual of 0.3 mg/L was detected once at the outfall; no chlorine was detected at Station 4 below the outfall.

- Fecal coliform concentrations were within Class A limits. Total coliform results were inconclusive: all samples produced plates with atypical colonies and heavy background growth.

Objective 2: Comparison of 1985 Data to 1981 Data

- An improved D.O. profile downstream of the outfall was observed. Causes of the 1981 D.O. sag were thought to be: sediment oxygen demand in slower areas of river, carbonaceous and nitrogenous oxygen demand of effluent, and heavy periphyton growth (Joy, 1983). The present mode of effluent treatment and discharge seem to have eliminated these causes of D.O. depletion.

- In 1985, less of a threat from ammonia and chlorine toxicity was noted. Effluent ammonia levels were much lower in 1985. Chlorine residuals were under better control, although the dechlorination mechanism needed adjustment for continuous chlorine removal.

- Effluent nutrient concentrations in 1985 were far lower than 1981 concentrations. In-stream nutrient loads below the outfall decreased at a more rapid rate in 1985 than in 1981 even though the dilution ratios were similar during the two surveys. Seasonal differences may have been a major factor.

Objective 3: Goldendale Make-Up Well Water Quality and Effects

- The sodium absorption ratio (SAR) of the well water was similar to the Goldendale WTP effluent SAR. Both pose a low salinity hazard and a moderate alkali (sodium) hazard for agricultural crops (Hem, 1970).

- The well water contained a similar concentration of nitrate as the Goldendale WTP effluent and higher phosphorus than the Little Klickitat at Station 1 above the well water entry point.

- At the rate of well water discharge observed during the survey, no significant impacts on river quality were apparent.

JJ:cp

Attachments

REFERENCES

Hem, J.D., 1970. Study and Interpretation of the Chemical Characteristics of Natural Water, 2nd ed. Geologic Survey Water Supply Paper 1473, U.S. Gov't. Printing Office, Wash. D.C. 363 pp.

Joy, J., 1983. "Little Klickitat River Receiving Water Survey in the Vicinity of Goldendale STP," memorandum to Alan Newman, Ecology Central Regional Office, April 20, 1983. 23 pp.

Joy, J., 1985. "Proposal for Goldendale/Little Klickitat Follow-up Survey," memorandum to Dick Cunningham, Ecology Water Quality Investigations Section, August 8, 1985. 3 pp.

Table 1. Station locations and sampling information for the low-flow receiving water study of the Little Klickitat River conducted in the Goldendale area on August 27 and 28, 1985.

Station Number	Location	Grab Samples and Measurements
1	Approx. 50 feet downstream from Pipeline Road bridge at mid-channel at river mile (r.m.) 16.3	Field: D.O., pH, cond., temp., flow Lab: FC, nutrients, pH, cond., turb., chloride, sodium, magnesium, and calcium
GW	Storm sewer outfall from left bank, behind abandoned stables at r.m. 14.9	Field and Lab same as station 1
2	Approx. 25 feet above confluence of Little Klickitat River and Bloodgood Creek at right bank	Field: D.O., pH, cond., temp., flow Lab: FC
BG	Bloodgood Creek 15 feet above mouth at mid-channel	Field: D.O., pH, cond., temp., flow Lab: FC, nutrients, pH, cond., turb., solids, BOD, chloride, sodium, magnesium, calcium
3	Upstream of staff gage located approximately 50 feet above bridge in mid-channel at r.m. 14.4	Field and Lab same as station BG
LE	Goldendale WTP post-dechlorination effluent 24-hour composite sample	
EFF	At mouth of WTP outfall in slow area of Little Klickitat River at r.m. 14.1	Field: D.O., pH, cond., temp., resid. chlorine Lab: FC, nutrients, pH, cond., turb., solids, BOD, COD, chloride, sodium, magnesium, calcium
4	Approx. 1000 feet downstream from WTP outfall, in the second riffle area at mid-channel at r.m. 13.9	Field and Lab same as EFF
5	Through pasture at home located 1.4 miles from Goldendale WTP facility on Horseshoe Loop Road - in riffle area at mid-channel at r.m. 12.6	Field and Lab same as BG
6	Approximately 25 feet downstream from Esteb Road Bridge at mid-channel at r.m. 10.5	Field and Lab same as BG

Table 2. Field and laboratory data from samples taken from the Litle Klickitat River near Goldendale on August 27-28, 1985. All values mg/L unless otherwise noted.

River Mile	Sta. No.	Location	Date	Field Data: Discharge (cfs)	Temp. (°C)	pH (S.U.)	Cond. (umhos/cm)	D.O. (mg/L)	D.O. % Sat.	TRC	Laboratory Data: F. Coli. (org/100 mL)	NO_3-N	NO_2-N	NH_3-N	O-PO_4-P	T-PO_4-P
16.3	1	L. Klickitat @ Pipeline Rd.	27	0.8	16.5	8.2	140	9.0	91.4		*	0.02	<0.01	0.03	0.01	0.04
			28	0.9	19.5	7.8	170	--								
16.1	GW	Municipal Well	27	0.3	17.1	7.2	575	9.2	94.1		*	0.55	<0.01	0.03	0.06	0.07
14.9	2	L. Klickitat @ Bloodgood Cr.	27	--	≈15	--	--	10.6	≈103		*					
			28	1.6	15.5	8.0	145	--			26					
			28	--	14.1	--	--	8.4	81.2							
--	BG	Bloodgood Cr.	27	3.6	11.3	7.4	110	11.0	100.0		*	0.09	<0.01	0.02	0.04	0.05
			28	3.5	11.9	7.6	110	--			150	0.07	<0.01	0.2	0.05	0.05
			28	--	9.9	--	--	10.2	89.9							
14.4	3	L. Klickitat @ Stream Gage	27	6.1	14.0	7.8	125	11.2	108.5		*	0.05	<0.01	0.02	0.03	0.05
			28	--	14.0	8.3	--	10.5	101.3		47	0.04	<0.01	0.02	0.04	0.04
			28		11.8	--	--	9.4	86.4							
--	LE	Goldendale Eff. (24-hr comp)		0.46	--	--	285		--			0.33	0.01	0.11	1.9	2.0
14.1	EFF	L. Klickitat @ Goldendale Outfall	27		17.2	9.1	230	10.0	103.1	<0.1	*	0.20	<0.01	0.09	1.00	1.68
			28		17.3	9.5	250	--		0.3	60	0.23	<0.01	0.14	1.3	1.97
13.9	4	L. Klickitat approx. 1000' blw Outfall	27	--	14.9	8.2	150	10.8	106.2	<0.1	*	0.06	<0.01	0.03	0.18	0.29
			28	--	13.6	8.5	150	10.2	97.5	<0.1	57	0.05	<0.01	0.03	0.12	0.25
			28	--	12.5	--	--	9.0	84.0							
12.6	5	L. Klickitat	27	5.7	16.6	8.2	145	11.2	114.1		*	0.02	<0.01	0.02	0.23	0.34
			28	6.0	13.4	7.6	130	9.8	93.2		100	0.03	<0.01	0.02	0.19	0.27
			28	--	--	--	--	--	--							
10.5	6	L. Klickitat @ Esteb Rd.	27	5.3	19.2	8.3	125	11.2	120.8		*	<0.01	<0.01	0.02	0.04	0.06
			28	5.4	14.6	7.7	135	9.9	96.7		96	<0.01	<0.01	0.02	0.12	0.17
			28	--	14.1	--	--	8.6	83.1							

River Mile	Sta. No.	Location	Date	Laboratory Data - continued: pH (S.U.)	Sp. Cond. (umhos/cm)	Turb. (NTU)	TS*	TNVS*	TSS*	TNVSS*	BOD_5	COD	Chloride	Na+	Ca+	Mg+	SAR
16.3	1	L. Klickitat @ Pipeline Rd.	27	7.6	128	1							1.5	7.9	9.7	6.5	0.48
			28														
16.1	GW	Municipal Well	27	7.5	454	3							3.9	31.6	16.7	22.2	1.19
14.9	2	L. Klickitat @ Bloodgood Cr.	27														
			28														
--	BG	Bloodgood Cr.	27	7.7	87	2	100	54	7	3			1.0	2.6	8.6	3.7	0.18
			28	7.7	82	2	120	74	5	3	<4		0.91				
14.4	3	L. Klickitat @ Stream Gage	27	8.0	100	2	120	66	8	3			1.7	6.3	8.7	4.3	0.43
			28	8.1	115	2	120	82	6	4	<4		1.6				
--	LE	Goldendale Eff. (24-hr comp)		9.6	234	8	280	130	48	4	26	120	30	41.0	12.1	4.5	2.56
14.1	EFF	L. Klickitat @ Goldendale Outfall	27	9.0	202	7	200	120	17	6	--	70	15.8	18.4	11.8	4.6	1.65
			28	9.1	195	6	--	--	--	--	18	76	19				
13.9	4	L. Klickitat approx. 1000' blw Outfall	27	8.2	113	2	120	63	10	4		14	4.0	7.7	7.4	4.4	0.54
			28	8.2	--	3	150	80	6	1	<4	11	3.5				
12.6	5	L. Klickitat	27	8.3	113	2					--		4.4				
			28	7.9	117	3	120	71	44	17	--		3.9				
10.5	6	L. Klickitat @ Esteb Rd.	27	8.5	100	2					--		2.0				
			28	7.9	110	2					<4		3.8				

*Samples exceeded recommended holding periods
< = Less than
SAR = Sodium absorption ratio

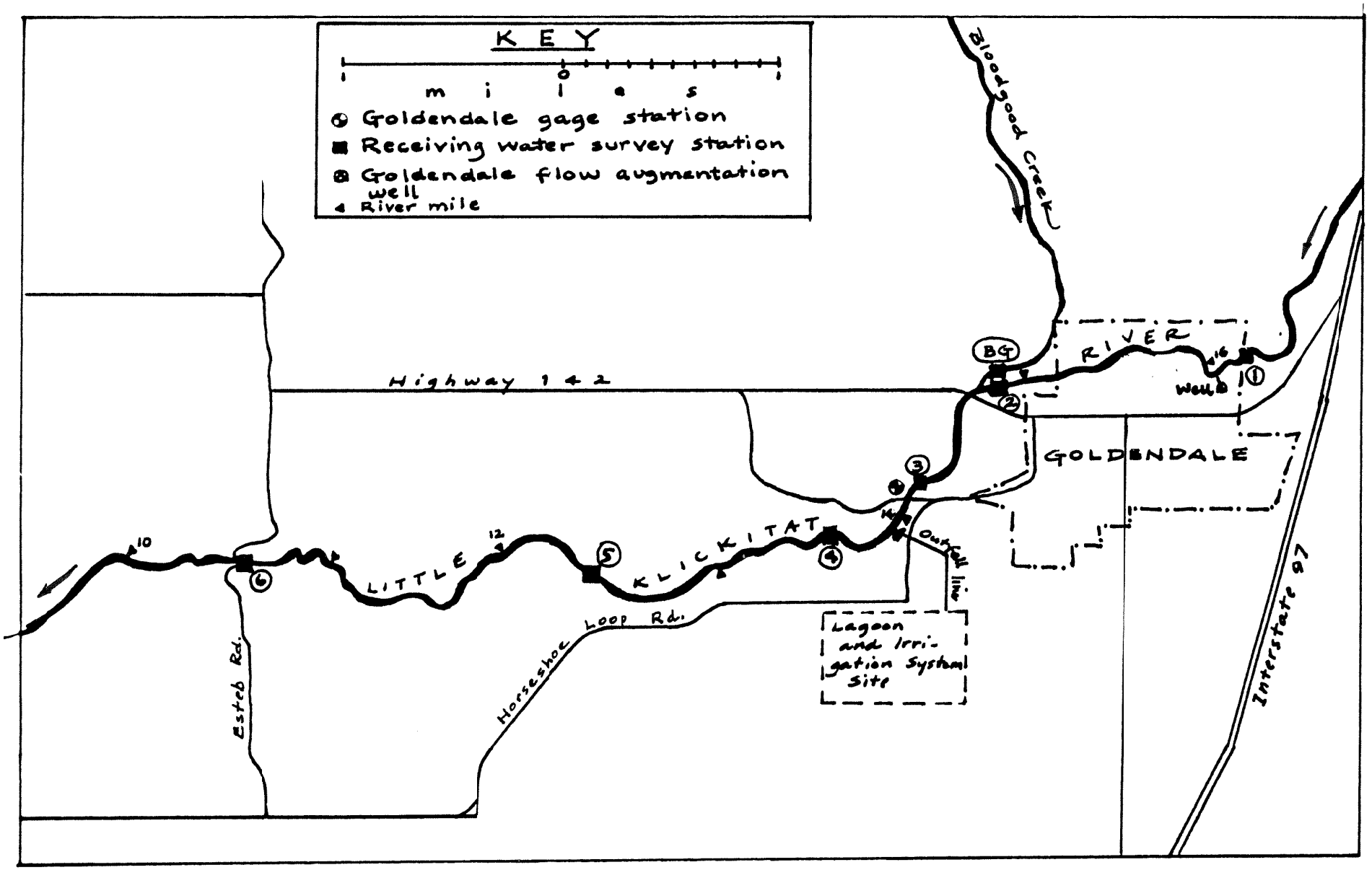

Figure 1. The Little Klickitat River in the vicinity of Goldendale and the new Goldendale wastewater treatment lagoon system. Receiving water stations for the August 27-28, 1985 low flow survey are indicated.

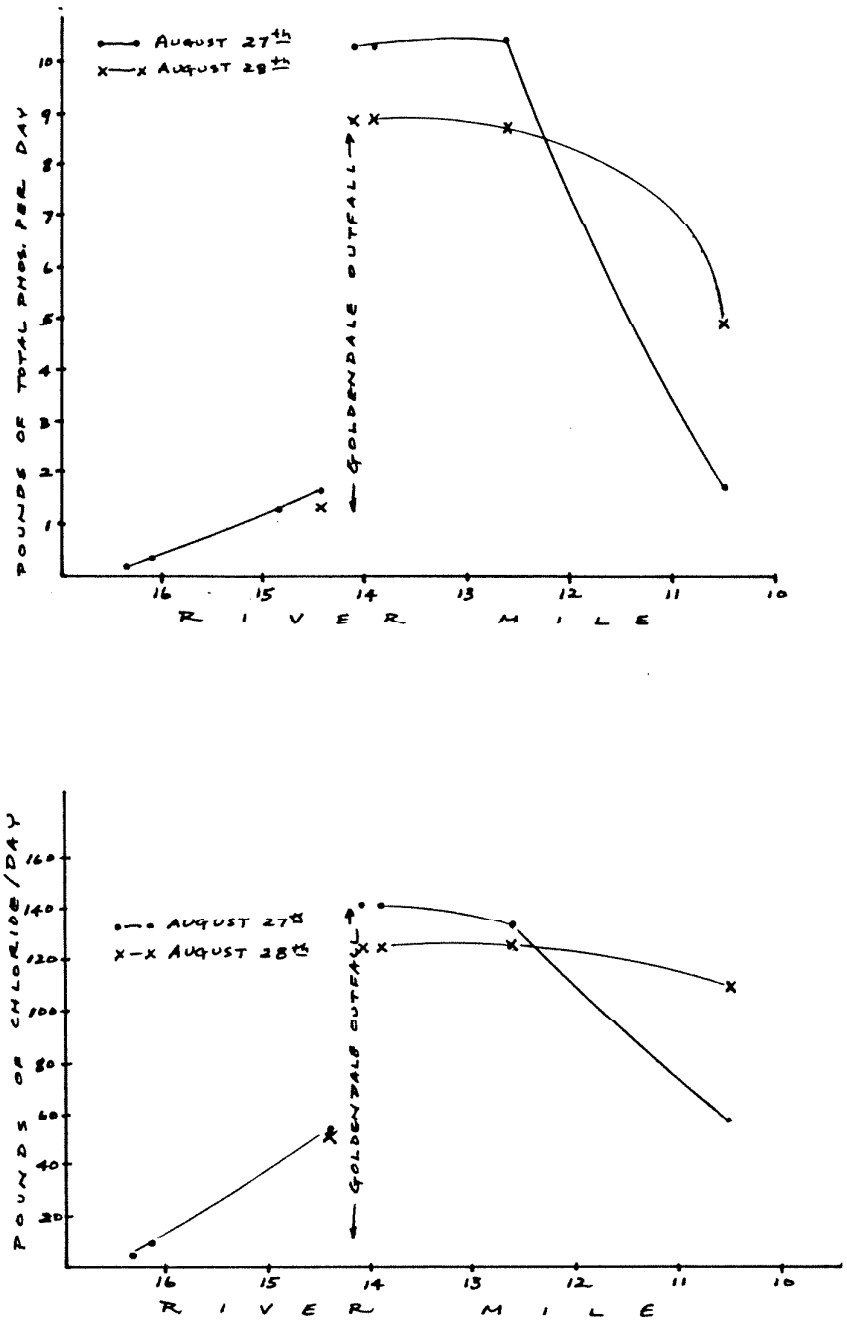

Figure 2. Total phosphorus (as P) and chloride loads in the Little Klickitat River in the vicinity of the Goldendale WTP outfall on August 27 and 28, 1985.